

ULTRAVIOLET SPECTROSCOPY OF METEORIC DEBRIS: IN SITU CALIBRATION EXPERIMENTS FROM EARTH ORBIT

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Introduction. We propose to carry out slitless spectroscopy at ultraviolet wavelengths from orbit of meteoric debris associated with comets. The Eta Aquarid and Orionid/Halley and the Perseid/1962 862 Swift-Tuttle showers would be our principal targets. Low light level, ultraviolet video techniques will be used during the night side of the orbit in a wide field, earthward viewing mode. Data will be stored in compact video cassette recorders. The experiment may be configured as a GAS package or in the HITCHHIKER mode. The latter would allow flexible pointing capability beyond that offered by shuttle orientation of the GAS package, and doubling of the data record. The 1100-3200 Å spectral region should show emissions of atomic, ionic, and molecular species of interest on cometary and solar system studies.

A major problem at the present time is an inability to accurately convert observed meteoric spectral intensities into compositional information. This problem could be circumvented and a significant amount of data on fundamental meteoric phenomenon could be obtained by the high-velocity injection of well characterized projectiles into the earth's upper atmosphere. This could be accomplished quite easily if a rail gun were available on the space station as part of the microgravity cratering facility (or for other reasons). Projectiles launched from a rail gun in earth orbit could enter the atmosphere at velocities as high as 25 km/s. Optimal viewing of such artificial meteors could be achieved if the gun and detector systems were located on separate platforms several hundred kilometers apart.

Discussion. Analysis of middle to far ultraviolet spectral data of meteoric debris of cometary origin has yet to be carried out. Objectives of such a study include the observation of many atomic species, both neutral and ionized, including the strong feature due to MgI at 2850Å and the strong blend at 2800Å due to MgII and MnI. An interesting possible metal emission is that of BeI at 2349Å.

Carbon is an expected constituent of comet-associated meteors. Though spectral features can exist in the visible region, carbon cannot be observed due to masking, principally by iron. The 1000-2000Å region should be relatively free of FeI and FeII emission allowing observation of CI at 1193Å, CI at 1330Å, CI at 1561, and CI at 1657Å. In addition, strong SiI and SiII emissions exist in the region suggesting determination of the C/Si ratio. Lines of SiO could also be observed at 1310Å.

Lyman alpha emission occurs at 1215Å due to hydrogen from dissociating H₂O and hydrocarbons. The video technique allows examination of the temporal development of the expected strong Lyman alpha emission from cometary sources. Sulfur lines occur at 1807Å and 1820Å; phosphorus lines occur at 1672Å, 1675Å, 1680Å, and 1775Å. Sulfur is a relatively abundant component of carbonaceous chondrites and its existence in cometary debris is of interest. The recent IUE observations by the Univ. of

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Maryland group, led by A'Hearn revealing dimer sulfur (S_2) emissions between 2820A and 3090A of comet IRAS-Araki-Alcock, makes the search for meteor sulfur all the more interesting.

Instrumentation. The experiment makes use of high speed (f ratio of 0.75) reflecting optics viewing a 12° by 12° field with an objective grating. The imaging detector is an intensified solid-state array having the following characteristics:

1100-3200A	6 ma/watt sens. (1500A)
UV intensified CID	20 ma/watt sens. (2500A)
244 x 388 pixels	CsTe/MgF ₂ p.c./wind.
8.7 x 11.4 mm	ex. ITT F.4561

The dispersing element would be a 300 l/mm grating blazed for first order with a 250 A MgF₂ protective coating. Fig. 1 displays the proposed optical configuration.

In the GAS configuration, video data will be stored in a stack of up to four compact video cassette recorders. Depending upon recording speed, a total record duration for the four-stack would be eight to twenty-four hours. Because data is recorded for approximately twenty minutes per orbit, data would be gathered over twenty-four to seventy-two orbits. Control would be by microprocessor and total power required would be less than 1.2 KWH from a battery pack of less than 1 ft³ and 100 lb.

A HITCHHIKER configuration would allow greater volume by utilizing shuttle power and additional GAS type containers for data storage. The optics/detector could then be gimbeled to allow some pointing capability.

